

Five species of *Candelaria* and *Candelariella* (Ascomycota, Candelariales) new to Switzerland

Martin Westberg¹, Philippe Clerc²

¹ *Cryptogamic Botany, Swedish Museum of Natural History, P.O. Box 50007, SE-104 05, Stockholm, Sweden*

² *Conservatoire et Jardin Botaniques de la Ville de Genève, CP 60, CH-1292 Chambésy/GE, Switzerland*

Corresponding author: *Martin Westberg* (martin.westberg@nrm.se)

Academic editor: *I. Schmitt* | Received 7 February 2012 | Accepted 19 March 2012 | Published 30 March 2012

Citation: Westberg M, Clerc P (2012) Five species of *Candelaria* and *Candelariella* (Ascomycota, Candelariales) new to Switzerland. MycoKeys 3: 1–12. doi: 10.3897/mycokeys.3.2864

Abstract

Candelaria pacifica, *Candelariella antennaria*, *C. boleana*, *C. granuliformis* and *C. xanthostigmoides* are reported from Switzerland for the first time. *Candelariella xanthostigmoides* is also new to Europe. *Candelariella aggregata*, *C. efflorescens*, *C. subdeflexa* and *C. viae-lactea* are confirmed to occur in Switzerland. *Candelariella antennaria* is also reported new to Austria. Brief notes on their identification, ecology and distribution in Switzerland are given.

Key words

Candelariaceae, *Candelariomycetidae*, Europe, lichens, lichenized ascomycetes

Introduction

Candelariella is a well-known and commonly occurring genus, growing on many types of substrates, particularly in exposed and nitrogen-enriched localities. The species of the genus are a prominent component of the lichen flora on e.g., road-side trees, limestone rocks and in alpine, terricolous habitats. However, the knowledge of the distribution and ecology of individual species is still poor for many species. It appears that few lichenologists collect and study *Candelariella*, possibly because of the presumed difficulties in correctly identifying the species. In Switzerland, a large number of recent collections of *Candelariella* exists due to field work done in the framework of the Red List of threatened and rare epiphytic and terricolous lichens in Switzerland (Scheidegger and Clerc 2002). Part of this study led to the first terricolous lichen inventory in Switzerland where all vegetated landscapes were explored between 1996 and 1997 (Vust 2011). A detailed revision

of the herbarium material filed under *Candelariella* and *Candelaria* at the Conservatoire et Jardin botaniques de la Ville de Genève (G), revealed six new species to Switzerland not mentioned in the recent checklist of the Swiss lichens (Clerc and Truong 2010). One of these, *C. aggregata*, was recently reported for Switzerland (Spinelli 2011) and the remaining species are reported here with brief descriptions of important characteristics of the species together with notes on their ecology and distribution in Switzerland. One of the species, *C. antennaria* is also reported new to Austria. We want to emphasize that many species can be readily identified. Collecting and studying them is a rewarding effort as there are many interesting discoveries to be made in this neglected group of lichens.

Notes on the species

***Candelaria pacifica* M. Westb. & Arup. Bibl. Lich. 106: 352. 2011.**

Mycobank: MB 541817

http://species-id.net/wiki/Candelaria_pacifica

Holotype. U.S.A. California: San Luis Obispo Co., Along Shell Creek Rd 0.3 miles N of junction to State Route 58. 35°28'N, 120°20'W. Alt. c. 400 m. 26 July 1998, *M. Westberg* 953 (LD!, isotype S!).

New to Switzerland. This species was recently formally described and reported from Europe as well as North and South America (Westberg and Arup 2011). Compared to *C. concolor* (Dicks.) Stein, *C. pacifica* is characterized by an arachnoid appearance of the lower surface of the lobes due to the lack of a cortex (see also photographs in Bomble 2012). It also has 8-spored asci (polyspored in *C. concolor*) but it is rarely fertile in Europe. *Candelaria pacifica* is widespread in Europe and common at least in the north-western parts, e.g., in the southern half of Scandinavia (Westberg and Arup 2010) but its frequency and ecology is not well known outside Scandinavia. In Switzerland it is apparently much less common than *C. concolor* and we have so far only seen a few specimens from Graubünden, Jura and Valais. *Candelaria concolor* on the other hand is common in Switzerland and also noticeably spreading, possibly due to nitrogen pollution.

Specimens examined. Graubünden: Scuol, alt. 1990 m, 22 Sept 1998, *Roth* (G 00298405); Zernez, alt. 1550 m. 20 June 1997, *Vust* (G 00298079); Jura: Le Noirmont, Le Creux-des-Biches, alt. 1020 m., 8 Aug 1996, *Groner* (G 00298072); Valais: Zeneggen, Eich, 1010–1030 m, 19 Nov 2010, *Clerc* (G 00057817).

***Candelariella aggregata* M. Westb. Bryologist 110: 393. 2007.**

Mycobank: MB 529546

http://species-id.net/wiki/Candelariella_aggregata

Holotype. U.S.A. Colorado: Larimer Co., Trail Ridge, 0.5 mi SE of Ranger Station, NW of Tombstone Ridge, 11500–11700 ft alt., 30 June 1962, *R. A. Anderson* 2229 (COLO!, isotype BRY!).

Candelariella aggregata was recently reported from Europe for the first time from the Murmansk Region in Russia (Urbanavichus and Urbanavichene 2008) and also from Switzerland (Spinelli 2011). It is a terricolous species growing in arctic-alpine areas as well as in dry, steppe-like habitats in North America, Asia and Europe (Westberg 2007b, Westberg and Sohrabi manuscript). It is recognized by its yellow granular to areolate thallus, numerous and often crowded apothecia with a thin margin (Fig. 1). The asci are 8-spored with narrowly ellipsoid spores $(14-15-18(-21) \times 5.0-6.0 \mu\text{m})$. Compared to e.g., *C. aurella* (Hoffm.) Zahlbr it also has a proper exciple that does not form a distinct stipe below the hymenium and the structure of the exciple is paraplechtenchymatous with thin cell-walls (Westberg 2007b). *Candelariella aggregata* appears to be common in the continental parts of Switzerland in steppe-like habitats at low altitudes or on well lit calcareous walls on south-facing slopes at higher altitudes.

There is a large variation in thallus morphology, apothecia and in spore size in 8-spored terricolous material in Switzerland. Possibly several species are involved and this group is clearly in need of revision. The name *C. unilocularis* (Elenkin) Nimis has been used for a terricolous species with a well-developed thallus and long spores but this name is a synonym of *C. aurella* (Khodosovtsev 2005, Westberg and Sohrabi in press). Material of the long-spored species from the Swiss Alps will be described in a forthcoming paper (Otte and Westberg, in prep.).

Specimens examined. Graubünden: Ardez, alt. 1491 m, 11 Oct 2007, *Vust* (G 00298392, G 00298400); sous l'église de Feldis, alt. 1470 m, 6 June 1999, *Clerc* (G 00298388); Fetan, Mot da l'Hom, alt 2380 m, 24 July 1956, *Frey* (G 00298391); National Park, Piz Pisoc, 29 July 1934, *Frey* (G 00298390); Tarasp, alt. 1440 m, 10 Aug 1995, *Vust* (G 00298398); Tarasp, alt. 1420 m, 12 June 1998, *Vust* (G 00298389); Valais: Bagnes, LaLy, alt. 2350 m, 24 July 2008, *Vust* (G 00298397, 00298399); Charrat, alt. 518 m, 2 Oct 2007, *Vust* (G 00298394); Guttet/Leuk, alt. 1000 m, 18 Oct 1997, *Vust* (G 00298403); Loèche, alt. 855 m, 7 Aug 1997, *Vust* (G 00298395); Mauvoisin, alt. 2740 m, 15 Aug 1998, *Vust* (G 00298413); Mazembroz, alt. 600 m, 28 April 1999, *Vust* (G 00298402); Rarogne, Heidnischbiel, alt. 759 m, 16 Oct 2007, *Vust* (G 00122115); Saillon, colline du château, alt. 504 m, 20 Sept 2007, *Vust* (G 00298396); Saillon, W part of the Saillon hill, alt. c. 500 m, 19 Nov 2010, *Westberg 10-178, 10-182* (S F177773, F177825); Vex, les Crêtes, alt. 1083 m, 5 Aug 1996, *Vust* (G 00298404); Zeneggen, alt. 1315 m, 15 Oct 2007, *Vust* (G 00298393, G 00298401); Zeneggen, Eich, 1010-1030 m, 19 Nov 2010, *Westberg 10-193* (S F178469).

***Candelariella antennaria* Räsänen. Anales Soc. Ci. Argent. 128: 137. 1939.**

Mycobank: MB 365342

http://species-id.net/wiki/Candelariella_antennaria

Holotype. ARGENTINA, Mendoza: Depto. Las Heras, pr. Quebrada de la Meina la Atala, 2 July 1937, *A. Ruiz Leal* (H!).

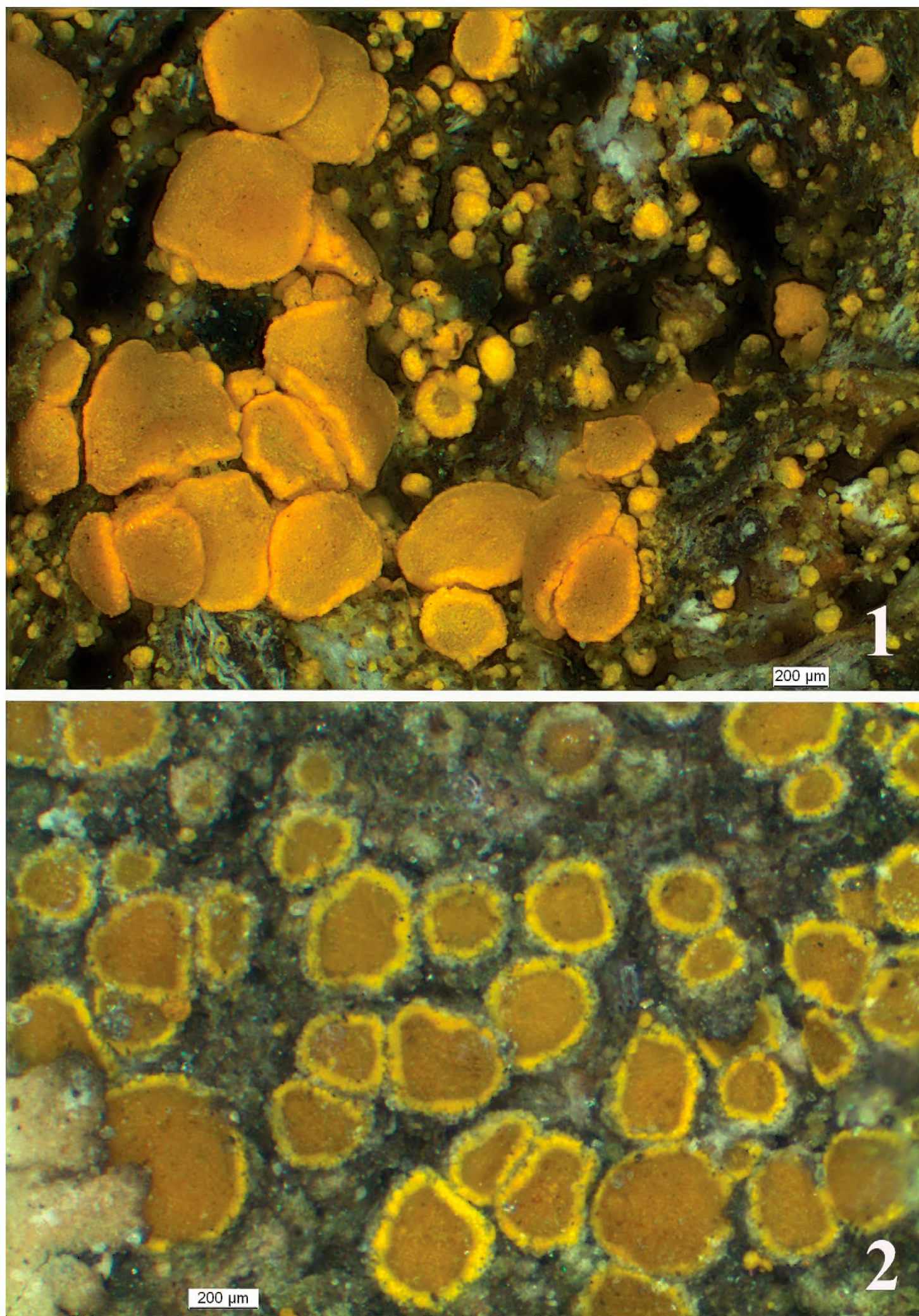


Figure 1, 2. 1 *Candelariella aggregata* – granular thallus and crowded apothecia with thin margins
2 *Candelariella antennaria* – grey thallus, composed of scattered to contiguous areoles or indistinct and with lecanorine, flattened apothecia

New to Switzerland and Austria. *Candelariella antennaria* is a corticolous or lignicolous species characterized by a grey thallus and 8-spored asci. The Swiss specimens were earlier identified as *C. viae-lacteeae*. This species also has a grey thallus but it is uniformly composed of sphaerical granules, whereas the thallus in *C. antennaria* is contiguous or with scattered, convex areoles or indistinct but never distinctly granular (Fig. 2). *Candelariella antennaria* was first reported from Europe from Crete by Vondrak et al. (2008). There are several specimens from Switzerland, all from the continental valleys in Valais and Graubünden. In addition we have seen one specimen from Tirol in Austria. *Candelariella antennaria* probably has a circumpolar distribution in continental, dry regions but the name possibly represents a complex of species.

Specimens examined. Austria. Tirol: Wipptal bei Steinach am Brenner, alt. 1100 m. 10 Sept. 1973, *Wunder* (M 0140870); Switzerland. Graubünden: Brusio, Casat, am Poschiavino, alt. 661 m, 30 Aug 1995, *Groner* (G 00298383); Sent, alt. 1490 m, 20 June 1995, *Frei* (G 00298382); Valais: Eggerberg, alt. 900 m, 30 Sept 1997, *Frei* (G 00298386); Naters, alt. 675 m, 22 July 1997, *Frei* (G 00298385); Ried-Brig, alt. 890 m, 22 July 1997, *Frei* (G 00298387); Sion, Préjeux, alt. 490 m, 23 Aug 1995, *Keller* (G 00298384); Viège, alt. 650 m, 22 Sept 1997, *Frei* (G 00298364); Pfynwald, Preissen, alt. 600 m, 19 Nov 2010, *Westberg 10-199* (S F178476).

***Candelariella boleana* Etayo, Palice & T.Sprib. Nova Hedwigia 89: 546. 2009.**

Mycobank: MB 513429

http://species-id.net/wiki/Candelariella_boleana

Holotype. SPAIN, Huesca, Central Pyrenees, Biescas, valle de Asieso, Barranco de Sta. Elena, 30TYN2126, 1100 m. 5 Aug 1993, *J. Etayo 13812* & *A. Gómez-Bolea* (BCC-Lich., isotype herb. Etayo).

New to Switzerland. This newly described species is similar to *C. xanthostigma* (Ach.) Lettau but is easily identified by its sphaerical spores (ellipsoid in *C. xanthostigma*). Its distribution is little known and it has hitherto been reported from Greece, Slovakia and Spain (Etayo et al. 2009). All Swiss specimens were collected on deciduous trees in the lowest part of the montane belt between 700 and 1000 m. Only one specimen was collected in the framework of the Red List project and was identified as *C. xanthostigma*. The small granular, corticolous species is a difficult group in *Candelariella*. When sterile it is often not possible to identify the different species. The thallus in *C. boleana* is granular or becoming somewhat areolate with deeply incised areoles, up to c. 0.15 mm wide (Fig. 3). The Swiss specimens also showed aggregates of smaller granules (20–30 µm wide) here and there which could be interpreted as either groups of young granules or blastidiate soredia formed by disintegration of mature areoles. We do not know whether this is a characteristic feature of *C. boleana*.

Specimens examined. Bern: Frienisbergwald bei Bern - Meikirch, alt. 820 m, 15 June 1960, *Frey* (G 00298408); Fribourg: kleiner Wald zwischen Vaulruz und Sem-sales, westlich Les Ponts d'Amont, alt. 880 m, 1 July 1969, *Frey* (G 00122116); Nid-

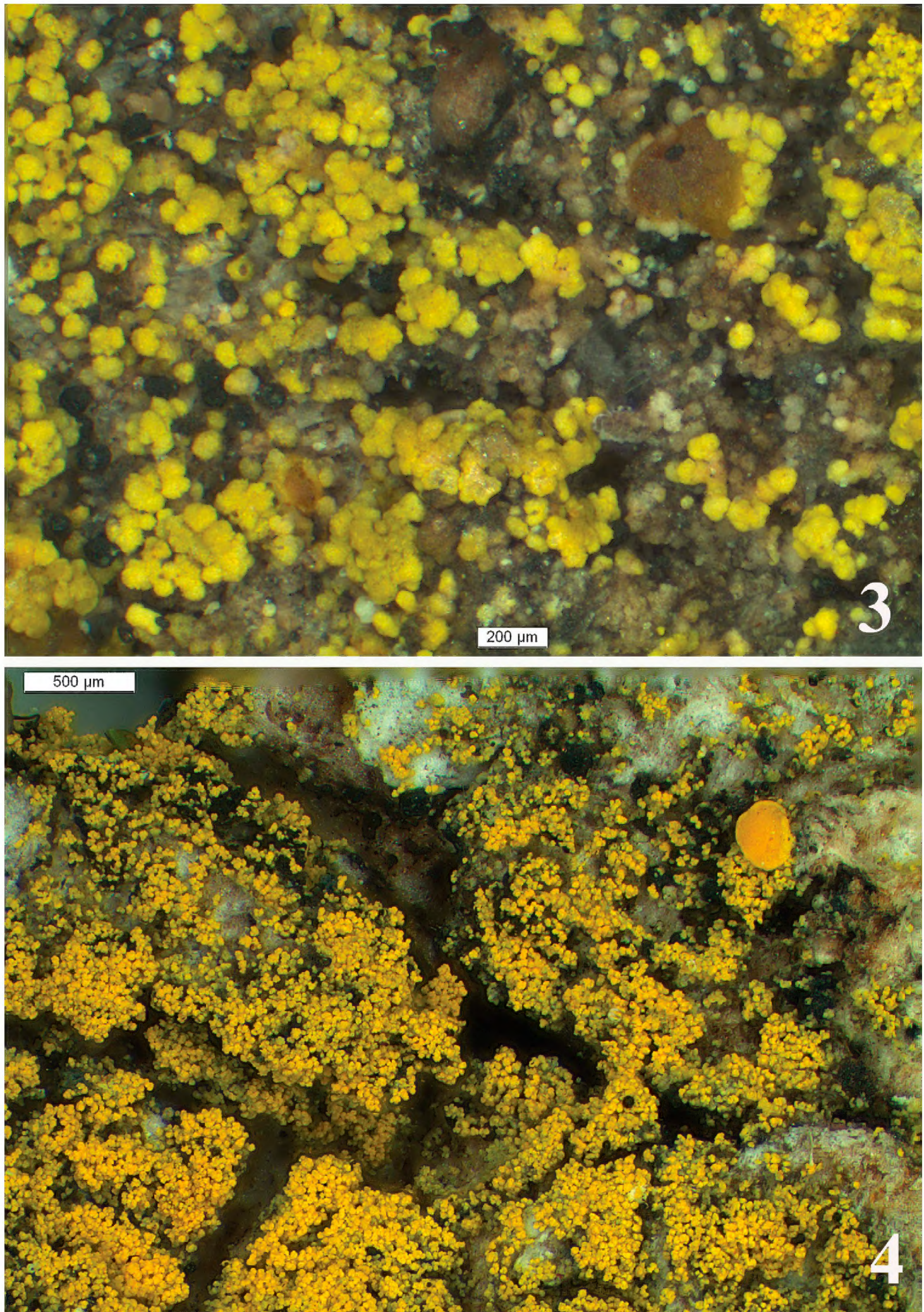


Figure 3, 4. *Candelariella boleana* – granular thallus becoming somewhat areolate with deeply incised areoles, or showing aggregates of smaller granules here and there **4** *Candelariella efflorescens* – granular thallus dissolved into soredia, appearing as a confluent sorediate crust

wald: Emmetten, Alt Berg, alt. 985 m, 25 July 1995, *Frei* (G 00298380); Zug: Sihltal bei Unterschwand, alt. 660 m, 1964, *Erb* (G 00298381).

***Candelariella efflorescens* R.C.Harris & W.R.Buck. Michigan Bot. 17: 155. 1978.**

Mycobank: MB 341677

http://species-id.net/wiki/Candelariella_efflorescens

Holotype. U.S.A. Michigan: Mackinac Co.: Edge of swamp across highway from Island Point State Forest campground (Hog Island State Forest Campground). 5 Oct 1974, *W. R. Buck* (MICH, isotype H!).

We can here confirm the presence of *C. efflorescens* (Fig. 4) in Switzerland by reporting six fertile specimens with c. 30-spored asci. They were collected mainly in the montane belt on deciduous and coniferous trees, mostly close to the ground. The three specimens collected in the framework of the Red List project were identified as *C. xanthostigma*. As most of the specimens of the small, sorediate *Candelariella* species are sterile, it is usually not possible to separate between *C. efflorescens* and *C. xanthostigmoides* (see under this species) and sterile specimens are referred by us to *C. efflorescens* agg.

Specimens examined. Bern: Lauterbrunnen, Stechelberg, alt. 1000 m, 23 Oct 1996, *Keller* (G 00298407); Graubünden: bei Strada unterhalb der Brücke, alt. 1070 m, 7 Aug 1962, *Frey* (G 00298406); Malix, alt. 1700 m, 27 May 1999, *Dietrich* (G 00057815); Seewis im Praetigau, alt. 1240 m, 22 Sept 1995, *Groner* (G 0057816); Valais: Pfynwald, Preissen, alt. 600 m, 19 Nov 2010 *Westberg 10-200* (S F178475); Zeneggen, Eich, alt. 1010-1030 m, 19 Nov 2010, *Westberg 10-188* (S F178464).

***Candelariella granuliformis* M.Westb. Bryologist 114: 328. 2011.**

Mycobank: MB 519356

http://species-id.net/wiki/Candelariella_granuliformis

Holotype. CANADA. Nunavut: Kitikmeot. Victoria Island, Wollaston Peninsula, Foulaise Bay. Lat/long: 69:28N 114:42W. Alt.: 100 m. 24 July 1999, *Jan-Eric Mattsson 5209* (UPS L-105166!).

New to Switzerland. This is a recently described arctic-alpine species reported from North America and northern Scandinavia (Westberg et al. 2011). This is possibly a circumpolar species and it is not surprising that it has now been found in Switzerland. The thallus is composed of small granules (Fig. 5) that soon disintegrate into blastidia (35–80 µm diam.) and the asci are polyspored. It is reminiscent of the corticolous species *C. xanthostigma* but the substrate and the disintegrating areoles separate it from this species. Of the other terricolous species *Candelariella aggregata* has 8-spored asci and *C. vitellina* has a much larger thallus of minute, effigurate areoles-subsquamales. The Swiss specimens were all collected in the continental parts of the country and were left unidentified until this study.

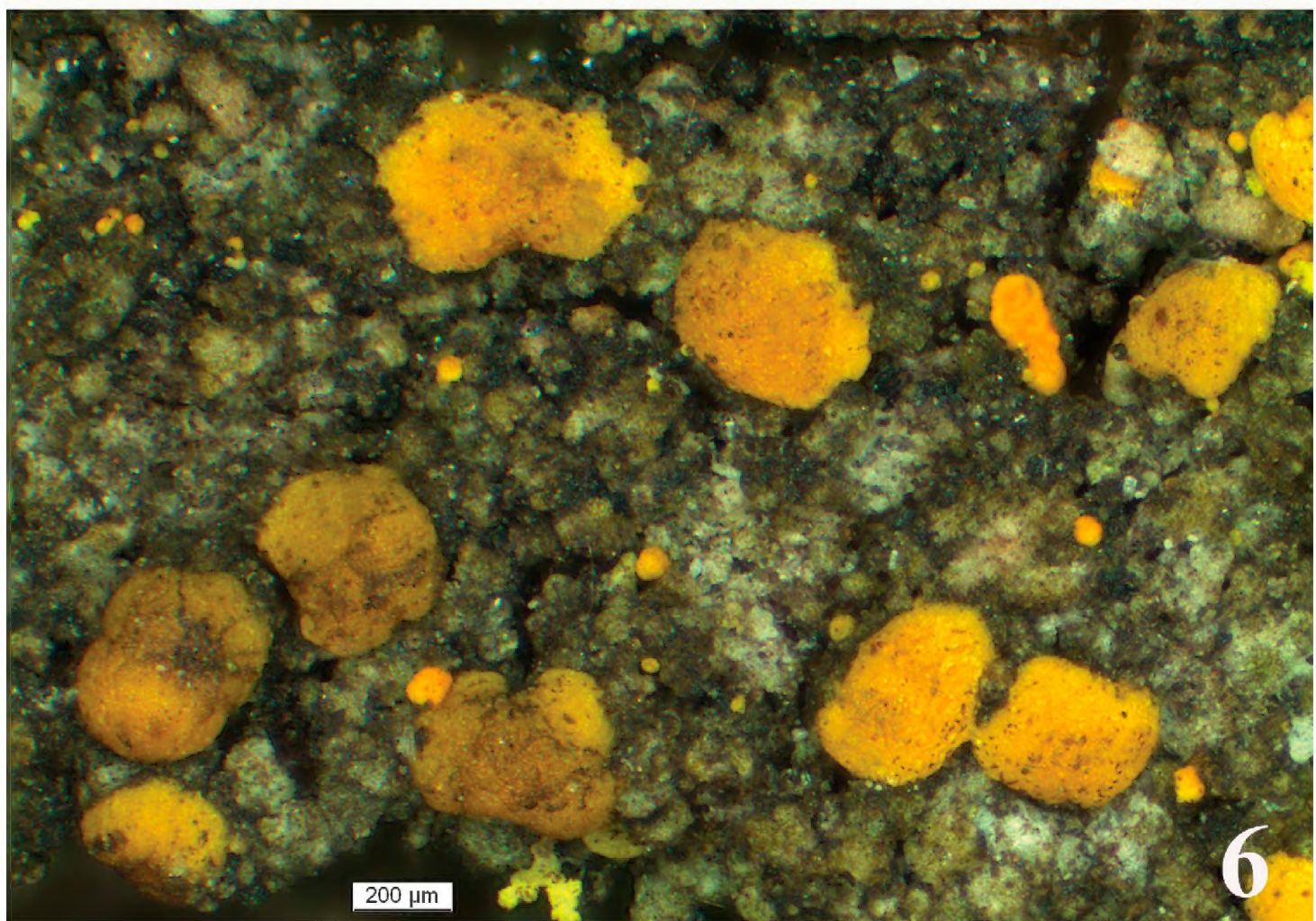
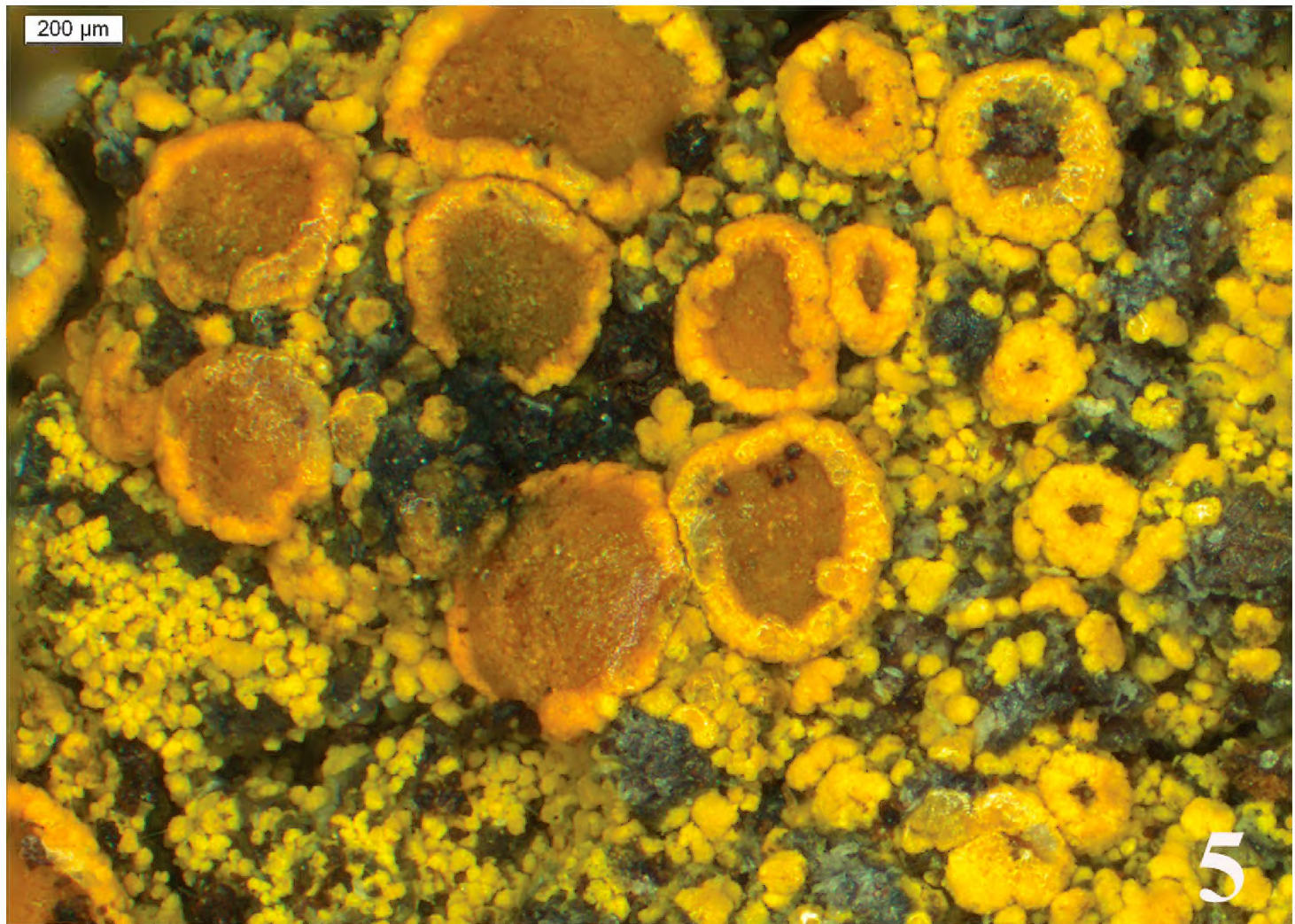


Figure 5, 6. **5** *Candelariella granuliformis* – lecanorine apothecia on a granular thallus with small granules soon disintegrating into blastidia **6** *Candelariella subdeflexa* –inconspicuous, grey thallus and biatorine apothecia

Specimens examined. Graubünden: Scarl, Tamangur, alt. 2100, 24 July 1934, *Frey* (G 00298409); Valais, Cabane des Dix, alt. 2850 m. 14 Aug 1998, *Vust* (G 00298081); Vallon de Réchy, alt. 2370 m, 15 Aug 1996, *Vust* (G 00298080).

***Candelariella subdeflexa* (Nyl.) Lettau. Hedwigia 52: 196. 1912.**

Mycobank: MB 381926

http://species-id.net/wiki/Candelariella_subdeflexa

Basionym. *Lecanora subdeflexa* Nyl., Flora 62: 355. 1879.

Lectotype. FRANCE. [locality uncertain] 1871, *Weddell* (H-NYL 29173! designated by Westberg 2007a: 369).

Candelariella subdeflexa was first reported from Switzerland by Lettau (1956) but remained overlooked until it was collected several times within the framework of the Red List project. The species was described in detail in Westberg (2007a) based on North American material. It is unusual, but not unique, for a *Candelariella* in having biatorine apothecia (Fig. 6). North American populations typically have a thallus composed of grey, shiny squamules. The material from Europe and North Africa, seen during this study has an inconspicuous grey thallus that is indistinct, granular or composed of scattered, grey, narrow and incised squamules. This is a rare species but easily overlooked as the apothecia are small, mostly c. 0.2–0.4 mm wide. It is known in Europe from Austria, France, Germany, Italy, Spain and Switzerland. The distribution within Switzerland is distinctly southern.

Specimens examined. Bern: Unterseen, Unteres Stadtfeld, alt. 560 m, 2 April 1997, *Keller* (G 00298366); Graubünden: Brusio, Scala, alt. 920 m, 30 Aug 1995, *Groner* (G 00298411); Luzern: Escholzmat, Irmibodenweidli, alt. 1120 m, 29 July 1996, *Frei* (G 00298365); Tessin: Malvaglia, Cregua, alt. 1233 m, 26 Sept 1995, *Keller* (G 00298368); Valais: Ausserbinn, Weng, alt 1270 m, 17 Sept 1996, *Frei* (G 00298366); Eggenberg, alt. 900 m, 30 Sept 1997, *Frei* (G 00298412); Ried-Brig, Schallberg, alt. 1400 m, 1 Sept 1998, *Frei* (G 00298367); Viège, alt. 650 m, 22 Sept 1997, *Frei* (G 00298364).

***Candelariella viae-lacteae* G.Thor & V.Wirth. Stuttgarter Beitr. Naturk., A, 445: 2. 1990.**

Mycobank: MB 354941

http://species-id.net/wiki/Candelariella_viae-lacteae

Holotype. HUNGARY, Bács-Kiskun Prov.: Kecskemét area, Fülöphaza (20 km W of Kecskemét), alt. c. 150 m. 1987, *G. Thor* 7015 (S!, isotypes STU, VBI).

Candelariella viae-lacteae is characterized by its grey thallus, uniformly composed of spherical granules (Thor and Wirth 1990). Previous collections of this species from Switzerland have turned out to belong to other species, mostly *C. antennaria*, another

species with a grey thallus. However, a recent find of *C. viae-lacteeae* was made on mosses on a stem base of *Fraxinus excelsior*.

Specimens examined. Solothurn: Messen, alt. 500 m., 15 June 1998, *Zimmermann* (herb. E. Zimmerman).

***Candelariella xanthostigmoides* (Müll.Arg.) R.W.Rogers. *Muelleria* 5: 32. 1982.**

Mycobank: MB 108739

http://species-id.net/wiki/Candelariella_xanthostigmoides

Basionym. *Lecanora xanthostigmoides* Müll.Arg., *Flora* 65: 484. 1882.

Lectotype. AUSTRALIA. New South Wales: Parramatta, W. Woolls (G! [G00290997], designated by Rogers 1982: 32).

New to Europe. This species is morphologically identical to *C. efflorescens* and can only be separated when fertile on account of its 8-spored asci compared to the c. 30-spored asci in *C. efflorescens* (Lendemer and Westberg 2010). The majority of the small, sorediate specimens in *Candelariella* are sterile and the distribution and frequency of the two species is thus poorly known. We found three fertile specimens with 8-spored asci which correspond well in all characters to *C. xanthostigmoides*. These specimens were mostly collected in humid places on *Salix* sp., *Betula* sp. and *Alnus* sp. The two specimens collected in the framework of the Red List project were identified as *Candelariella reflexa* (Nyl.) Lettau, another 8-spored, sorediate species. The latter species is however morphologically distinct also when sterile (see Lendemer and Westberg 2010). Earlier, the name *C. solediosa* Poelt & Reddi had been used occasionally (e.g., Poelt and Vězda 1977) for similar specimens from Europe. We prefer to use the older name *C. xanthostigmoides* as the distinction between these two species is not clear and the type of *C. solediosa* is poor (see also Lendemer and Westberg 2010).

Specimens examined. Basel-Land: Arisdorf, alt. 435 m, 4 Aug 1998, *Frei* (G 00057814); Jura: Le Noirmont, alt. 985 m, 8. Aug 1996, *Groner* (G 00057813); Schwytz, Rothenturm-Sattel, alt. 910–960 m, 30 Sept 1969, *Frey* (G 00122119).

Acknowledgments

M. Westberg is supported by a grant from the Swedish Taxonomy Initiative (Svenska Artprojektet) administered by the Swedish Species Information centre (ArtDatabanken). The visit of M. Westberg to the G herbarium was financed by the Conservatoire et Jardin botaniques de la Ville de Genève. The Red List of threatened and rare epiphytic and terricolous lichens in Switzerland was financed by the Swiss Federal Office for the Environment. We thank Erich Zimmerman for letting us report his specimen of *C. viae-lacteeae*, the curator at M for sending material and two referees for useful comments on the manuscript.

References

- Bomble FW (2012) *Candelaria pacifica* and *Xanthomendoza borealis* im Aachener Raum – neu für Deutschland. Veröffentlichungen des Bochumer Botanischen Vereins 4: 1–8. http://www.botanik-bochum.de/html/publ/OVBBV4_1_Bomble_Candelaria_pacifica_Xanthomendoza_borealis.pdf
- Clerc P, Truong C (2010) Catalogue des lichens de Suisse. <http://www.ville-ge.ch/musinfo/bd/cjb/cataloguelichen> [Version 1.0, 01.03.2010].
- Etayo J, Palice Z, Spribille T (2009) *Candelariella boleana*, a new epiphytic species from southern and central Europe (Candelariaceae, Ascomycota). Nova Hedwigia 89: 545–552. doi: 10.1127/0029-5035/2009/0089-0545
- Khodosovtsev AE (2005) The genus *Candelariella* (Candelariaceae, Lecanorales) of the Southern Ukraine. Novitates Systematicae Plantarum Non Vascularum [Academia Scientiarum Rossica] 39: 233–248. (in Russian).
- Lendemer J, Westberg M (2010) *Candelariella xanthostigmoides* in North America. Opuscula Philolichenum 8: 75–81. http://sweetgum.nybg.org/philolichenum/biblio_detail.php?irn=247696
- Lettau G (1956) Flechten aus Mitteleuropa XI. Feddes Repertorium 59: 1–97.
- Poelt J, Vězda A (1977) Bestimmungsschlüssel Europäischer Flechten. Ergänzungsheft I. Bibliotheca Lichenologica 9: 1–258.
- Rogers RW (1982) The nomenclature of some Australian lichens described as *Lecanora* and *Placodium* by Müller-Argoviensis. Muelleria 5: 31–34.
- Scheidegger C, Clerc P (2002) Liste Rouge des espèces menacées en Suisse: Lichens épiphytes et terricoles. Ed. Office fédéral de l'environnement, des forêts et du paysage OFEFP, Berne, Institut fédéral de recherches WSL, Birmensdorf, et Conservatoire et Jardin botaniques de la Ville de Genève, CJBG. OFEFP-Série: L'environnement pratique.
- Spinelli A (2011) *Candelariella aggregata* M. Westb. neu für die Schweiz. Meylania 47: 18.
- Thor G, Wirth V (1990) *Candelariella viae-lacteeae*, a new lichen species from Europe. Stuttgarter Beiträge zur Naturkunde, Serie A, 445: 1–4.
- Urbanavichus GP, Urbanavichene IN (2008) Seven lichen species from Murmansk province new to Russia. Bulletin of Moscow Society of Naturalists Biological Series. 113(6): 77–78.
- Vondrák J, Guttová A, Mayrhofer H (2008) A further contribution to the knowledge of lichen-forming and lichenicolous fungi in Crete. Herzogia 21: 105–124
- Vust M (2011) Les lichens terricoles de Suisse. Mémoire de la Société vaudoise des Sciences naturelles, 24: 1–352
- Westberg M (2007a) *Candelariella* (Candelariaceae) in western United States and northern Mexico: the species with biatorine apothecia. The Bryologist 110: 365–374. doi: 10.1639/0007-2745(2007)110[365:CCIWUS]2.0.CO;2
- Westberg M (2007b) *Candelariella* (Candelariaceae) in western United States and northern Mexico: the 8-spored, lecanorine species. The Bryologist 110: 391–419. doi: 10.1639/0007-2745(2007)110[391:CCIWUS]2.0.CO;2
- Westberg M, Arup U (2010) *Candelaria concolor* – a rare lichen in the Nordic countries. Graphis Scripta 22: 38–42.

- Westberg M, Arup U (2011) *Candelaria pacifica* sp. nova (Ascomycota, Candelariales) and the identity of *C. vulgaris*. *Bibliotheca Lichenologica* 106: 353–364. doi: 10.1639/0007-2745-114.2.325
- Westberg M, Morse CA, Wedin M (2011) Two new species of *Candelariella* and a key to the Candelariales (lichenized Ascomycetes) in North America. *The Bryologist* 114: 325–334.
- Westberg M, Sohrabi M (in press) A conspectus of the lichen genus *Candelariella* in southwest Asia with emphasis on Iran. *Nova Hedwigia*.